A NEW METHOD OF TREATMENT FOR FRACTURE OF THE NECK OF THE FEMUR, TOGETHER WITH REMARKS ON COXA VARA.[1]

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My especial interest in fracture of the neck of the femur has been in the accident as it is seen in childhood. In previous papers I have endeavored, first, to establish the fact that it is not at all uncommon; second, to point out certain distinctions between the immediate and remote results of the injury in childhood and adult age; and third, to suggest treatment by which the disability might be remedied.

This treatment was directed more particularly to the resulting deformity than to the immediate injury, for in none of the cases reported was the patient seen by me until several weeks or months after the accident. In all the cases, nineteen in number, with but one exception, there was union, an average shortening of not more than three-quarters of an inch, and but little disability other than a slight restriction of motion, a moderate limp, and a certain discomfort during the stage of repair.

The rapid recovery from the injury indicates that in childhood the neck of the femur is forcibly depressed without complete separation at the point of fracture. The average result, therefore, in spite of non-treatment, is far better than that ordinarily attained in adult age. Yet the result is far from satisfactory, for depression of the neck of the femur, whether traumatic or otherwise, sufficient to cause even half an inch of shortening, predisposes strongly to further depression; consequently to a gradual increase of disability similar to that caused by coxa vara of the ordinary type.

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[1] Read before the New York Surgical Society, May 28, 1902.

For this reason I have suggested the advisability of breaking up the so-called impaction with the aim of reducing the deformity should an opportunity present itself; in other words, to treat this fracture as one would treat a green-stick fracture of the shaft of a long bone.

It is apparent that one cannot apply direct force for this purpose in this situation, but the desired result may be accomplished in another manner. The range of normal abduction of the thigh is dependent upon the upward projection of the neck of the femur, which normally forms an angle with the shaft of from 125 to 140 degrees. The extreme limit of passive abduction is reached when the neck and trochanter come into direct contact with the rim of the acetabulum. If the angle between the neck and shaft of the femur is lessened, the range of abduction is correspondingly restricted. As this limitation of abduction is a constant symptom of depression of the neck of the femur, restoration of the normal range would imply correction of deformity if the capsular ligament were normally resistant. Forcible abduction of the thigh is indicated therefore as a means of replacing the depressed neck of the femur. In this manœuvre one uses the rim of the acetabulum as a fulcrum, the shaft as a lever, and depends upon the lower border of the capsular ligament to fix the head of the femur. When the normal limit of abduction as compared with that of the other limb is reached, one may infer that the deformity has been reduced; for the weakened neck should give way before the capsule becomes sufficiently stretched to allow a subluxation of the head. If, then, the limb be fixed in this attitude of extreme abduction, repair should take place in an approximately normal position, even if the fracture were made complete by the manipulation. (Fig. 1.)

Recently I have had the first opportunity to test this treatment. A boy eight years of age was brought to me by his family physician on October 30, 1901. Three weeks before, he had fallen from a fire-escape to the pavement, a distance of about fifteen feet, sustaining bruises about the left hip, the resulting symptoms of discomfort, weakness, and local sensitiveness being aggravated by his attempts to walk. On examination, shortening of half an inch was found in the length of the limb; the left trochanter was prominent and elevated; motion was somewhat painful, and was limited by voluntary and involuntary contraction of the muscles. This limitation was most marked in the direction of abduction.

The child was anæsthetized, and it was then found that the movements of the joint were practically unrestricted except in abduction, which was limited to about half the normal range. The thigh was slowly and forcibly abducted in the manner described, to the normal limit as compared with its fellow, and the limb was fixed in the attitude of complete abduction by a long plaster spica bandage. Some weeks later this was replaced by a short Lorenz bandage, in an attitude of lessened abduction. At this time the

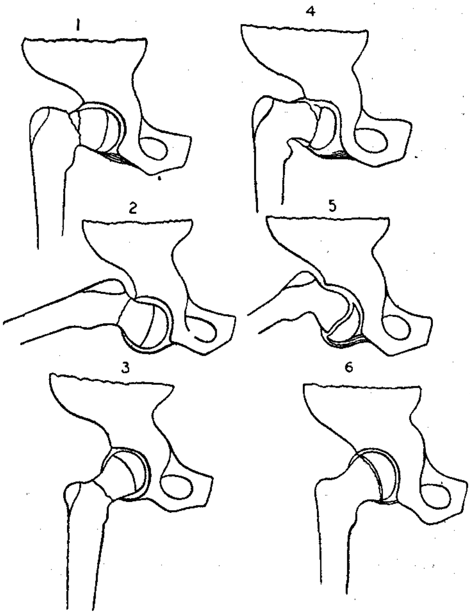

Fig. 1.—1. Fracture of the neck of the femur. 2. Restoration of the normal angle by forcible abduction. 3. The limb in normal position. Figs. 4, 5, and 6 illustrate separation of the epiphysis of the head of the femur treated by the same method.

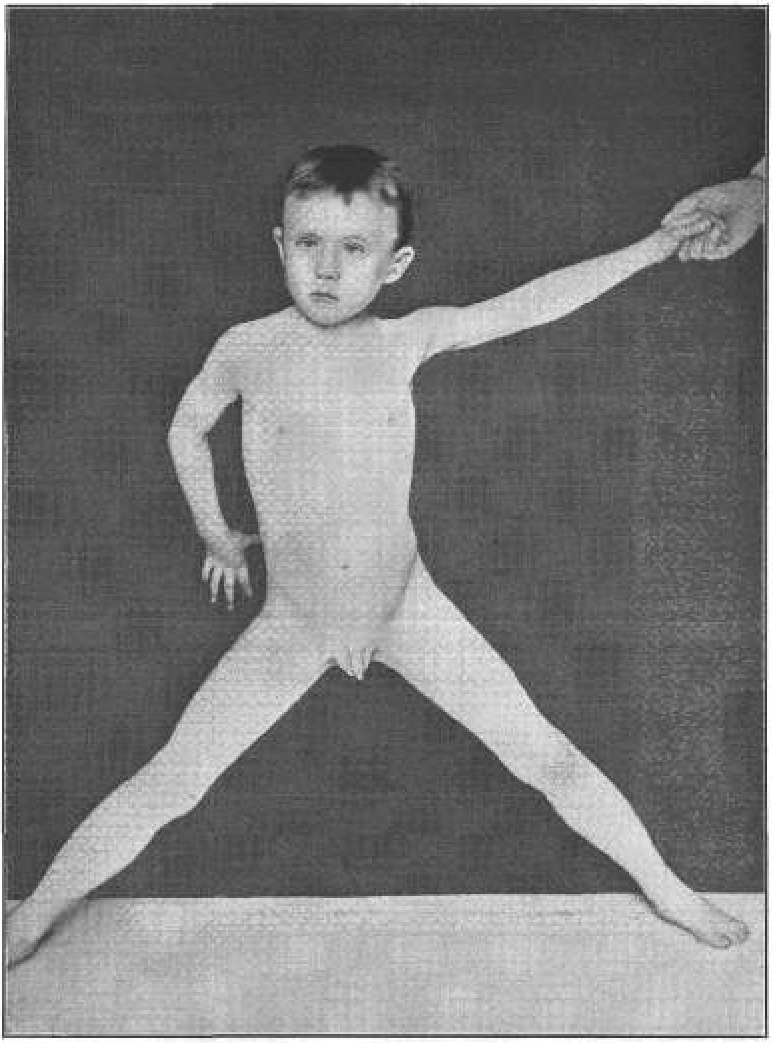

Fig. 2.—The patient after the removal of the plaster bandage, showing the restoration of the range of abduction.

limbs were of equal length; the trochanter was in normal relation to Nélaton's line, and the abnormal projection had disappeared.

It may be of interest to note that the child had been walking about practically from the beginning of treatment, the mother stating that it was impossible to keep him quiet after the discomfort had been relieved. On February 26, 1902, or about four months after the accident, all restraint was removed. There were at this time no physical signs of the accident, and a Röntgen picture showed restoration of the normal angle of the neck. The functional result is perfect.[1] (Fig. 2.)

I am convinced that the treatment adopted in this case, that is to fix the limb at the limit of normal abduction under anæsthesia by means of a plaster spica bandage, might be applied to patients of adult age with advantage, and that it offers a prospect of a far better ultimate result than that usually attained by the ordinary methods of treatment.

In the cases of this class that I have had the opportunity to examine, excluding those in which no serious attempts to secure union had been made, there is, as a final result, almost always shortening, marked limitation of abduction and, in many instances, fixed adduction of the limb with corresponding functional disability and its attendant discomforts. The disability is aggravated doubtless in certain instances by premature use of the weakened part, but it is caused primarily by a deformity that has never been reduced, or that, if reduced, has again recurred. The museum specimens show also, in many instances, either non-union or exuberant callus formation that must have interfered very decidedly with function. Such results indicate failure in the apposition and fixation of the fragments.

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[1] Since this paper was written, the method has been applied in a second case. The patient, a girl six years of age, was brought to the hospital for Ruptured and Crippled on August 21 of the present year. Three weeks before, she had fallen from a second story window, injuring the left hip.

For two weeks she was practically confined to bed, and, as the limp and discomfort persisted, it became apparent that the injury was more serious than had been supposed. The symptoms and physical signs were identical with those of the preceding case, as was the treatment. After the limb had been forced to the limit of abduction, it was replaced in the normal attitude for comparison with its fellow. The abnormal projection of the trochanter had disappeared and the limbs were of equal length, a convincing demonstration of the fact that the deformity had been rectified. The child is still wearing a support, but complete cure is practically assured.

I need not review the familiar methods of treatment of this injury. It is sufficient to say that if the aim is reposition and subsequent retention in normal position, they are faulty in conception and in practice. If, however, the patient were anæsthetized, and if, under traction and counter-traction, the thigh were abducted, it would seem that the outer fragment which would be turned downward and inward would be far more likely to be brought into apposition with the inner fragment than when the limb is held in the line of the body. If reposition were attained, it could be assured by the long plaster spica bandage, for this would provide the anteroposterior support that is lacking in the ordinary splints; while upward displacement, supposedly caused by muscular action, would be prevented by the direct contact of the outer extremity of the neck and the trochanter with the rim of the acetabulum and side of the pelvis.

The plaster bandage is said to be uncomfortable and inefficient, but from my own experience with it, both in the treatment of children and of adults, I am inclined to think that the discomfort is due rather to its improper application and to the failure of subsequent supervision than to any inherent defect of the method. The only appliance that compares with it in efficiency of support is the Thomas hip-brace; but this is equally difficult of adjustment, and it does not permit the attitude of abduction, which is the point of special interest in this connection.

I again take the opportunity to call attention to the statement in the text-books of general surgery that fracture of the neck of the femur is extremely uncommon, except in old age, a statement manifestly misleading and untrue. In addition to twenty cases of fracture of the neck of the femur in childhood and adolescence that I report, I have seen during the past year five cases in early adult life (twenty-eight to forty-five years). One patient had been examined by an ambulance surgeon and assured that he was simply bruised. One was discharged after a stay of two days in a hospital with the same assurance. Two patients had been treated in a hospital for fractures at the ankle, the injury of the neck of the femur having escaped notice. In the last case no diagnosis had been made. In all these cases the fracture was undoubtedly impacted, and it would seem that in this class, as in childhood, the fracture is often incomplete.

It would appear from my own experience that it is a correct diagnosis, rather than the fracture, that is uncommon, and I should suggest the importance of careful measurement in all cases of injury about the hip, for if one found actual shortening of the limb, he could scarcely overlook the confirmatory signs of fracture.

As regards the treatment of impacted fracture, I may state that under favorable conditions I should not hesitate to attempt to reduce the deformity in the manner already described, a procedure which is a radical departure from traditional methods.[1]

Fixation in the attitude of abduction has been considered thus far with especial reference to the fracture itself, but it should be of service also in preventing the additional limitation of the range of abduction, caused by accommodative shortening of the muscles during the period of fixation.

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[1] I am now able to report a case in which the method has been applied. A woman, twenty-eight years of age, was referred to me for diagnosis on January 29, 1902. Five weeks before this she had fallen on the street, injuring the right hip. She was assisted to her home, and had since remained in bed. On examination, the limb was found to be flexed and adducted. Motion was painful, and was restricted by voluntary and involuntary spasm. Under anæsthesia the distortion was reduced, but it was impossible to force the thigh to the extreme limit of abduction, apparently because of the changes incidental to repair. The limb was placed, therefore, in moderate abduction and a Lorenz spica was applied. Four weeks later the patient was allowed to go about on crutches. At the present time (October) the patient walks with but slight limp. There is half an inch of shortening and practically no restriction of motion. This result is not as perfect as that attained in the two other cases reported, but it is certainly satisfactory.

There is another point in the treatment of fracture of the neck of the femur that deserves consideration. This is the desirability of protection of the weakened part for a time, after ambulation is resumed. For it is probable that functional use before repair is complete may increase the deformity and aggravate, it may be, the so-called rheumatoid changes that are sometimes observed after fracture. For this reason I have employed, in the after treatment of some of these disabled patients, the ordinary hip splint as a traction appliance in the more painful cases, or as a simple perineal crutch when complete or partial removal of the strain was indicated. This support relieves the discomfort and enables the patient to walk about without the aid of crutches. It is perhaps needless to insist upon the importance of massage and of forcible manipulation for the purpose of resisting the tendency towards adduction of the limb, as an adjunct to mechanical treatment whenever it is practicable.

I have placed what may be considered the more practical part of this paper in a section by itself. There are, however, other points of interest that are involved in a consideration of disability due to deformity of the upper extremity of the femur. For example, the exact location of the injury of the neck of the femur in childhood is of importance, at least from the stand-point of prognosis. I have always contended that, when subjected to direct violence, the neck of the femur should break at its weakest part, or about its centre, rather than at the epiphyseal junction; for this is the thickest part of the bone, and it is protected by a strong rim of cartilage, which is far more elastic than the bone. Moreover, that free motion at the hip-joint, except in abduction, when there are three-quarters of an inch shortening of the limb, as in the majority of the cases that I have reported, is an almost positive indication that the injury does not involve the articulating surface of the head of the bone. For if there were true epiphyseal separation to the extent that would explain this shortening, the irregularity within the joint would cause far more serious functional derangement. This contention has been supported in a number of cases in which X-ray was available for diagnosis, and by several anatomical specimens as well. I may state again, therefore, that, in all but very exceptional cases, in childhood the neck of the femur will give way at some distance from the epiphyseal junction. In adolescence, however, the newly formed bone about the epiphyseal cartilage is apparently a weak point. This is indicated by the fact that the deformity of coxa vara of the adolescent type is often most marked at this point. Such cases of coxa vara in which the disability is suddenly increased by a fall, or even by a slight injury, may be mistaken for true primary epiphyseal separation, and several cases have been reported as such. The following case is an example of this class.

A boy, fourteen years of age, of large size, who had for several years used a crutch because of amputation of the thigh, was brought to me on January 2, 1902. Eight weeks before this time he had slipped and injured the right hip. Immediately after the fall he was placed in bed, and remained there for two weeks, suffering somewhat from discomfort and stiffness in the joint. For about six weeks he had been about on crutches. There were marked flexion and adduction of the thigh and almost complete limitation of motion in all directions. A diagnosis of partial epiphyseal separation was confirmed by an X-ray picture. On careful questioning, it then became evident, from a history of increasing discomfort and stiffness in the hip-joint for several months before the accident, that the injury had simply hastened the progress of coxa vara of the epiphyseal type.[1]

This case is identical with two reported by Sprengel (*Archiv für klinische Chirurgie,* Band xlvii, S. 805) in youths respectively seventeen and eighteen years of age, in which epiphyseal displacement followed slight injury. In both cases discomfort and a certain degree of disability had preceded the accidents for an indefinite time. Such cases should not be classed as examples of epiphyseal separation in normal subjects, nor are they of particular importance in their bearing on the question of the relative frequency of fracture and epiphyseal separation in childhood, as is assumed by Sprengel and by others. That true epiphyseal separation may occur is of course admitted. The following case, that I have already reported, is an example.

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[1] This patient was treated by the forcible abduction method, and at the present time the result appears to be very satisfactory.

A boy, sixteen years of age, came to the Hospital for Ruptured and Crippled on October 10, 1899, walking with the aid of a crutch. Three weeks before, while playing foot-ball, his left thigh was violently abducted. This strain was followed by pain and weakness, which so increased on the use of the limb that he required assistance to reach his home. The attitude of the limb was one of slight flexion and outward rotation. There was an inch of shortening with corresponding elevation of the trochanter, and motion was much restricted in all directions. A Röntgen picture showed partial epiphyseal separation. The later history of this case differs from that of fracture of the neck of the femur in that motion of the joint has remained restricted as at the first examination. At the present time there is nearly two inches of actual shortening, which is increased to three inches by adduction of the limb.

I think it is fair to conclude that, as compared with fracture of the neck of the femur, epiphyseal separation is uncommon; that it is more likely to occur in adolescence than in childhood, and that in certain of the reported cases progressive deformity of coxa vara of the epiphyseal type preceded the injury. True epiphyseal separation should be treated in the manner suggested for ordinary fracture, as abduction of the thigh would be the attitude most likely to approximate the fragments. Excision of the head of the femur as performed in Sprengel's cases can hardly be recommended as a treatment of routine. The immediate result of excision, in the sense of restoration of motion, is favorable; but, as a rule, progressive shortening and deformity follow, because there is in most instances upward displacement of the shaft upon the pelvis, with disability similar to that of dorsal dislocation of the hip. If, therefore, an open operation is performed, one should either attempt to actually replace the head of the bone or to simply cut away the projecting portions that interfere directly with movement. Afterwards an osteotomy of the shaft may be indicated to restore the normal angle of the neck.

The discussion of the immediate rectification of traumatic depression of the neck of the femur offers an opportunity for a further note on the treatment of the deformity when direct replacement is impracticable, as in the ordinary type of coxa vara, traumatic or otherwise. In such cases, after the forcible stretching of the contracted tissues, one should restore the normal angle between the shaft and the neck by removing a sufficient wedge of bone from the base of the trochanter. In this operation, as I have suggested in former papers, a portion of the cortex at the apex of the wedge on the inner side of the femur, opposite the trochanter minor, should be preserved. The thigh is then gently abducted, and, the trochanter and neck being fixed by direct contact with the upper border of the acetabulum, further abduction closes the wedge-shaped opening. The limb is then retained in this attitude of complete abduction by a plaster spica bandage until union is complete. The short, or preferably the Lorenz, spica will fix the part securely, for, as the continuity of the femur is unbroken, there is no danger of rotation or other displacement of the fragments. Within a few weeks the patient may be allowed to walk upon the limb, for in this attitude of complete abduction the body is so inclined towards the limb that the line of weight is practically that of the neck of the femur, and functional use that does not entail overstrain aids repair. (Fig. 3.)

This operation, performed in the manner described, is better adapted to the treatment of children than for older patients, because in the latter class what might be called retroversion of the neck is usually combined with the depression. In fact, in certain instances, this retroversion, which rotates the foot outward and limits the flexion of the thigh, may be of greater importance than the actual depression, as is illustrated in the following case.

A woman, twenty years of age, applied for treatment at the Hospital for Ruptured and Crippled because of stiffness and discomfort of indefinite duration in the right hip. She could not walk a block without extreme fatigue, nor could she sit with comfort because of the difficulty of flexing the hip. There was slight adduction of the thigh, which was so increased by flexion that the patient was obliged to cross the leg over its fellow when she assumed the sitting posture; there was also outward rotation of the limb and a marked limp. In this case the depression of the neck of the femur was so slight that there was less than half an inch of actual shortening, the physical signs depending in great degree upon its retroversion. On July 11, 1901, after preliminary stretching of the secondary contractions of the soft parts, the femur was divided below the trochanter minor. The shaft was then rotated inward sufficiently to bring the foot into

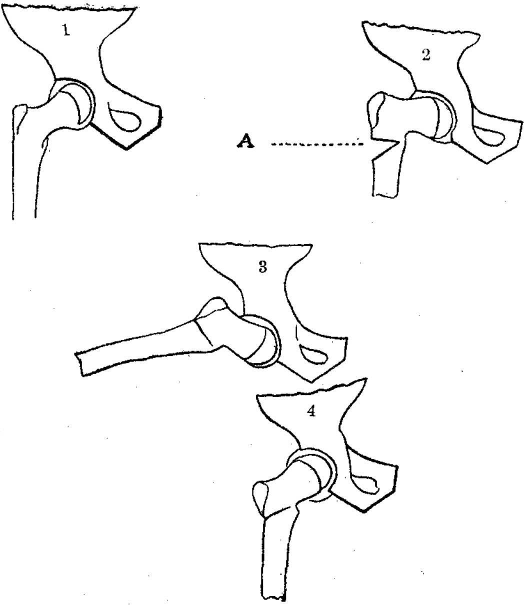

Fig. 3.—1. The normal femur. 2. Depression of the neck of the femur—coxa vara. *A*. A wedge of bone has been removed. 3. Abduction of the limb first fixes the upper segment by contact with the rim of the acetabulum, then closes the opening in the bone. 4. Replacement of the limb after union is complete elevates the neck to its former position.

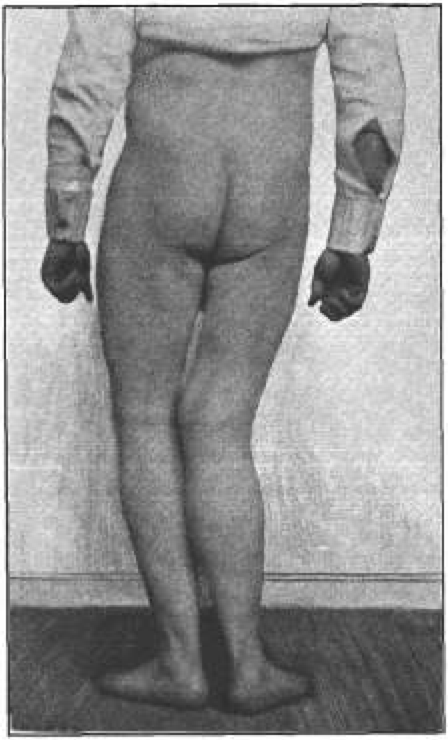

FIG. 4.—Bilateral coxa vara in adult life, illustrating complete loss of abduction of the thighs.

normal position, and the limb was fixed in an attitude of moderate abduction by a long spica plaster bandage. Eleven weeks after the operation she resumed her work as a servant. At a recent examination the limbs were found to be equal in length, flexion was possible nearly to a right angle, and the patient stated that she could walk a distance of several miles without discomfort.

In cases of this type, and, in fact, in the majority of cases of the adolescent type, simple linear osteotomy is the operation of choice.

Although cases of coxa vàra in the progressive stage are sufficiently common, comparatively few of the remote results have been reported. In this connection the following case may be of interest.

A man, fifty-two years of age, was seen in October, 1901. He stated that at the age of sixteen he had suffered from obscure symptoms of discomfort in the hips and thighs with gradually increasing disability, until at the age of twenty, in spite of, or as he thinks because of, the various remedies that were prescribed, he became bed-ridden. He then discontinued all medicine, and thereupon improved rapidly and regained his usual health, although the limitation of motion at the hip-joints persisted, making locomotion somewhat difficult. Within the past year or more he had again begun to suffer discomfort, more particularly in the right hip. Examination showed typical bilateral coxa vara. The patient was unable to separate the thighs more than a few inches, and had always walked with one limb behind the other. Motion was extremely limited in both joints, and apparently there were so-called rheumatoid changes on the right side which were the cause of his more immediate discomfort. It is interesting to note that until this time he had not been informed of the nature of his disability. This case is an illustration of late, although even after thirty years, not a final result of neglected deformity. (Fig. 4.)

It may be stated that there is no possibility of a spontaneous cure of coxa vara, in the sense of restoration of the normal angle between the shaft and the neck of the femur. During the progressive stage of the affection there is usually local discomfort in the weakened part and, as a result, secondary muscular spasm and contraction. When the progress of the deformity is checked by the resistance of the compressed bone, and by relief from strain incident to the enforced inactivity of the patient, repair begins. The muscular spasm disappears; the contracted tissues relax somewhat under use, and an unconscious adaptation lessens the functional disability. This completes the so-called cure.

If a diagnosis of coxa vara is made in the early stage, its further progress may be checked, temporarily at least, by appropriate mechanical support. This treatment will relieve the secondary muscular spasm and the direct discomfort in the more advanced cases. It must be continued, however, for an indefinite time, and there is a probability of the recurrence of the symptoms when ordinary use of the limb is again permitted. It is essentially a palliative rather than a curative treatment. For this reason I am in favor of the operative procedures that have been described, whenever they are practicable.

The most favorable cases are, of course, those of the unilateral type in which the depression involves the neck as a whole. In this class perfect functional cure may be expected. The least favorable are the cases of the rapidly progressive bilateral type in which the distortion is most marked in the vicinity of the head of the femur. In cases of this class, forcible abduction of the thighs in the manner described may correct in some degree the deformity, and it may be employed as a tentative measure when more radical treatment seems to be contraindicated. (Fig. 5.)

It is well known that knock-knee and bow-leg can be cured by immediate over-correction of the deformity, and, as has been stated, simple coxa vara may be as effectively remedied by the same treatment. This statement would hardly require argument were it not that the nature of coxa vara has been obscured by the inferences and speculations of those who have written upon it. Certain writers speak of the deformity as an effect of a " recrudescence of general rickets;" others explain

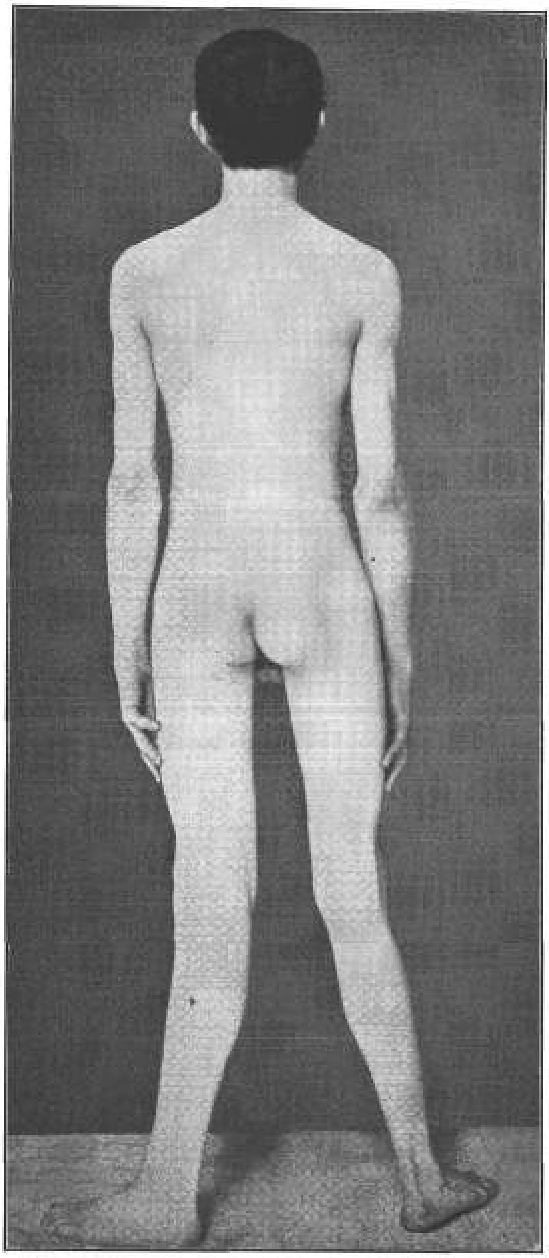

FIG. 5.—Typical bilateral coxa vara in adolescence, showing the greatest possible separation of the thighs and the outward rotation of the left limb.

it by the assumption of a peculiar local disease that begins without cause and ends as mysteriously. It is a matter of common observation that, in the cases of coxa vara of later childhood and adolescence, there is practically never general rhachitis, and there is no adequate evidence to support the assumption of local osteomalacia as a cause of the deformity. Certainly, if such a disease were present. the distortion would recur after operative treatment, yet in my experience this has never happened.

It is reasonable to assume that in many instances the deformity of coxa vara as seen in adolescence is, like other deformities of this class, simply an exaggeration of a slight preexistent distortion. This develops in adolescence because this period of rapid growth and instability is a period of weakness, when, too, the burden of laborious occupation is often assumed. Coxa vara to a slight degree is often present in ordinary infantile rhachitis, as has been demonstrated by Fiorani, but it is masked by the more evident distortions of the long bones. As it is usually slight in degree, it does not cause of itself noticeable symptoms, although, as has been stated, it is undoubtedly a predisposing cause of more extreme deformity in later life.

In certain of the cases of adolescent coxa vara, particularly of the bilateral form, the patients may present every evidence of general weakness, but even in this class a very much larger proportion suffer from weak feet or round shoulders or knock-knees than from coxa vara. This general weakness, incidental to rapid growth, may be exaggerated, of course, by improper food and environment. It is a predisposing cause of any bodily deformity; it should be recognized both in preventive and curative treatment, but it hardly deserves the title of rickets, recrudescent or otherwise.

It is well known that the angle formed by the shaft and neck of the femur is considerably less in the adult than in the child, a gradual depression being incident apparently to growth. In certain instances the femoral necks may be abnormally weak and delicate in structure, or the presence of congenital fissures in the neck, as described by Wolff, may predispose to abnormal depression as the part develops. The effect of injury in actually causing the deformity has been mentioned, and it is probable that the injury as a predisposing cause of coxa vara is a more important factor in the etiology than has been generally believed. Finally, it may be admitted that there may be instances in which the deformity is caused by the local softening that has been mentioned. It is certain, however, that in most cases the congestion and weakness that have been found at operation are the results of progressive deformity rather than its cause.[1]

In conclusion, I present a summary of the cases of depression of the neck of the femur that have come under my observation. Twenty-one of these were traumatic (fracture) and fifty-two were simple coxa vara, a total of seventy-three cases.

Statistics of Fracture of the Neck of the Femur in Early Life.—Sex, males, 10; females, 11. Age, two to three years, 2; three to six years, 8; six to nine years, 7; sixteen years, 2; eighteen years, 2. Nature of the accidents: One patient fell from the sixth floor of a house; two patients fell from the window of a fourth floor; one patient fell from the window of a third floor; one patient fell from the window of a second floor; seven fell from heights averaging fourteen feet; four fell down flights of stairs; one was run over by a cart; one was knocked down by a street-car; one was injured in a game of foot-ball; in one case the history is indefinite.

In one case the patient was treated in a hospital, and in this case excision of the head of the femur was performed because of non-union. In two cases already described the deformity was rectified soon after its occurrence. The remaining eighteen cases received no immediate treatment for the injury.

Statistics of Coxa Vara.—Sex, males, 37; females, 15.

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[1] In this review of the etiology of coxa vara, those cases due to evident local or general disease in which the deformity is, as it were, incidental, have not been considered.

Age (when the patients applied for treatment): Adolescence (twelve to eighteen years), 33; later childhood (five to eleven years), 15; adults, 4. Age when symptoms were first noticed: Adolescence, 28; later childhood, 15; childhood, 8; indefinite, 1. Character of deformity: It was bilateral in nine cases, unilateral in forty-three,—twenty-three of the right and twenty of the left side. In three instances the distortion was apparently forward and downward; in three directly downward, and in forty-six it was downward and backward.

Many of the cases were observed before the X-ray was available for exact diagnosis, and in other instances this examination was impracticable. It is estimated, however, that in about one-quarter of the cases the deformity was most marked in the vicinity of the head of the femur (epiphyseal coxa vara). This is especially common in those cases that develop rapidly in adolescence. In the remaining three-quarters the entire neck was depressed (cervical coxa vara). In fourteen there was a definite history of infantile rhachitis. In many cases no definite conclusion could be reached on this point, and in the larger proportion of the cases there was no history or sign of this affection.